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Elements of modified school design for the physically disabled are considered, including mobility, classrooms, science laboratories, applied skill areas, the library, the swimming pool, and sanitary facilities. Also discussed are the cafeteria (food service, seating, and other considerations), recreational areas (play grounds, gymnasium-auditorium, and auditorium), closets and storage areas (clothing storage, lockers, and supplies and equipment storage), and parking areas (parking lots and loading areas). (JD)

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The Modification of Educational Equipment and Curriculum for Maximum Utilization by Physically Disabled Persons

Design of a School for Physically Disabled Students

Harold E. Yuker
Joyce Revenson
John R. Frecchia

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The Modification of Educational Equipment and Curriculum for Maximum Utilization by Physically Disabled Persons

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Design of a School for Physically Disabled Students

Harold E. Yuker
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FOREWORD

This present series of monographs represents a significant departure in the publications of the Human Resources Center. Up to this point the Center's monographs have been descriptive and attitudinal studies concerning the disabled worker. In contrast to these, the present series of five monographs are reports relating to the education of severely physically disabled children.

Although these reports have a wide perspective they focus on Human Resources School. This school has been one of our most successful experiments. We feel that it is important to provide others with information about the school, as well as information about other major successful attempts at educating physically disabled children. This series of monographs attempts to integrate the available information in this area.

The United States today is placing more emphasis upon better education for all. With this emphasis, the education of the severely disabled child, formerly considered homebound, has become increasingly significant. It is our hope that the information contained in this series will contribute substantially to the improvement of the quality of education offered to disabled children throughout the United States and the world so that they can become independent and productive citizens.

Henry Viscardi, Jr., LL.D., L. H. D.
President
Human Resources Center

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This series of monographs on the education of the severely disabled child is the result of the contributions of many people. Special recognition must be given to the faculty of Human Resources School for their important advice and meaningful criticisms, and the Human Resources research staff for their continuous cooperation. Without the help of all of these people, this series would not have been possible.

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PREFACE

The purpose of this series is to provide a comprehensive source of information pertinent to the education of physically disabled, intellectually normal children. The information presented should help those concerned to provide these children with an excellent education. A secondary purpose is to stimulate educators to think about problems that arise in educating physically disabled children, and to attempt to formulate their own solutions to these problems.

These publications are designed to fill a need for information about the education of physically disabled children. This need for information has been expressed by everyone from the school superintendent and the local school board to the classroom teacher and the physical and occupational therapists. The information explosion has not yet reached into this area. While many persons have worked out ingenious solutions to problems that arise, these solutions have not been publicized. There is a lack of communication. Someone, somewhere has probably solved any given problem, but few people know of the solution. Ultimately the regional curriculum centers in special education will provide this information. In the interim, the present series has been designed to "spread the word."

Thus, these publications are designed to serve as a preliminary, concise handbook of information about the education of physically disabled children. They present information about a wide variety of topics of interest to special educators. The material has been obtained from a number of sources. Much of it comes from a relatively extensive review of the literature. Over 800 books, articles, pamphlets, etc. were reviewed. Other information came from interviews with leading educators in various parts of the country.* Others, whom we were unable to visit made their contributions in writing.

The series of reports has been organized into five topics, each dealing with a major aspect of the education of disabled children. The discussion of each topic includes a general introduction, a series of problem areas each with a solution or solutions, a summary, and a list of references. The problems covered are generally those of greatest concern in the field; the ones most apt to arise when two persons concerned with the education of physically disabled children get together. The solution that is given is based on infor-

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*The authors would like at this point to formally express their thanks to the many persons who so willingly shared their information with us. Much of the information and inspiration in this series stems from these persons. While a complete list of persons who gave of their time is not appropriate here, it can be found in the Appendix at the end of each volume.

mation obtained from the sources described above. It represents our interpretation of the thinking current in the field today. In some cases, when more than one solution is discussed, it may indicate either that there is disagreement among the experts, or that the authors disagree with the experts. In such cases, the reader is invited to draw his own conclusions which he should do anyway even where only one solution is given. In other instances, the solutions presented represent alternatives for coping with various specific situations. The purpose of this series is as much to get people to think and come up with their own solutions as it is to provide ready-made solutions.

The bibliography at the end of each monograph is in some respects the most important part of the series. It lists the primary sources that provide the important details that were omitted from the present publications. In organizing this series a choice had to be made between breadth and depth. We decided to attempt to present a broad picture of the education of physically disabled children, sacrificing depth of presentation in the process. The depth can be provided by use of the references.

Both the solutions, and to a lesser extent the problems are permeated by the educational philosophy of the authors of this series. This philosophy can be expressed as a series of assumptions:

1. Good education is defined in terms of external criteria, and is judged according to these criteria. The principal goal is providing maximal educational opportunities to each individual regardless of whether he is disabled or non-disabled.

2. It is desirable for disabled persons to attend integrated schools whenever possible.

3. Facilities and curricula should be planned for optimum use by all students.

4. Specific individual needs should be provided for to the extent possible within the confines of statement #3.

5. Many of the special adaptations for disabled students can be useful for non-disabled students as well.

It is realized that some of these assumptions are arguable - and their pros and cons are discussed in the series. Nevertheless, it is important that the assumptions be understood since they will enable the reader to discount some of the biases that appear throughout the series.

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INTRODUCTION

One of the major problems facing the physically disabled child attempting to complete his formal education centers around architectural barriers which prevent access to both conventional and special education facilities. This monograph will focus on a number of recommendations that have been reported in the literature and/or have been used with success at Human Resources School. There are a number of basic assumptions which will be implicit throughout the discussion and certain concepts will be repeated in the interest of clarity and emphasis. At this point it may be useful to review some of the more basic ones.

Most contemporary experts in the field of special education recommend that the physically disabled child be afforded as much opportunity for independent behavior as possible. This is not only desirable in terms of the development of an adequate self-concept, but has certain obvious economic advantages as well in terms of reduction in number of staff and effective utilization of personnel. There is some disagreement among experts in this field in terms of the most effective means of accomplishing this goal which appears occasionally in this monograph and in actual practice as well. The source of disagreement among experts in the field rests largely upon the degree to which special facilities should be provided. Existing buildings may be modified or new structures may be planned to provide a higher degree of independence than is found in contemporary structures. Some of these modifications or plans may be executed with minimum expenditure, and at the same time, will promote maximum degree of independence. Some are likely to be quite expensive and could be justified only with a large number of physically disabled persons making use of such facilities who cannot function without them. It has been argued at points throughout this monograph and in other publications from Human Resources Center, that modifications to physical plant should be kept to a minimum. This argument is based upon the fact that once the individual leaves the special facility (an implied desirable goal) he will have to learn to function in a world that is not modified. It is recognized that some modification may be necessary as an intermediate step in adjustment to a conventional and perhaps poorly designed world for the physically disabled person, but proposed modifications should consider the fact that sooner or later the individual will have to operate effectively, productively, and independently without such aids. Certainly architectural plans for public and private buildings should not be developed without planning for the physically disabled. Frequently such planning makes the structure more accessible for physically normal persons with temporary disabilities, and the aged, and may generally ease movement throughout the facility (e.g. movement of heavy equipment on dollies). On the contrary, members of the staff at Human Resources Center have argued in public forums and in professional and lay journals that architectural planning should consider the needs of the physically disabled person (especially

those confined to wheelchairs) and that such plans need not be either inefficient or unattractive. The argument is that physically disabled persons must learn to be able to function effectively in the conventional world not that the conventional world should remain inefficiently designed forever.

Other experts in the field have suggested that there is no compelling reason for accepting limitations in the design of facilities. In many cases they have recommended what are essentially minor modifications which help the disabled person to function more effectively. Many of these have not been incorporated in the design of Human Resources School because the staff felt that the gains to be realized through the use of such modifications would not offset the possible development of dependence on such artificial aids.

This monograph has attempted to include samples of each philosophy in an effort to be relatively comprehensive and permit the reader to make a reasonably intelligent choice.

The primary considerations in the design of physical plant in a facility serving large numbers of disabled children or adults focus on four major principles. One is the range of movement available to most physically disabled people. This includes limitations in range of movement resulting from specific physical disabilities as well as those resulting from confinement in a prosthetic or orthotic device such as a wheelchair. These considerations influence the distances between objects and/or the height of placement. The second major consideration deals with the strength of the physically disabled subject. In general it can be assumed that physically disabled people have less physical strength than physically normal ones. As a result, design of certain units particularly those which move (e. g. doors) should include consideration of the weight involved and the nature of the movement required (e. g. pusn vs. pull). These considerations may be dealt with either through the material used in construction, or with mechanical devices such as hinges which can reduce the physical strength required for manipulation. Third, the dimensions of prosthetic devices, especially wheelchairs must be considered. This would include such factors as the turning radius of an individual chair, and number of wheelchairs likely to make use of the facility at any given time. Such considerations will influence the amount of space devoted to any particular sub-unit of the facility. Finally, due to the fact that many prosthetic devices including wheelchairs, braces, and crutches are made of hard materials, the design of an attractive as well as an efficient facility should consider that these devices may scratch or mar furniture, walls, and doors. As a result, provisions should be made to consider the use of materials that show minimum signs of wear and tear.

It is the contention of the staff at Human Resources Center that sound architectural planning can produce attractive, efficient, and economical physi-

cal facilities which may be used effectively by both physically disabled and normal persons. This monograph will attempt to describe some modifications to existing structures and to provide some general guidelines for the planning of new ones.

MOBILITY

According to Mackie (1952-1953) one way of establishing a sense of independence for a disabled child is to provide him with an environment in which he can move about with minimum help from others. Architectural barriers encountered in most conventional school buildings create difficulties for students who are confined to wheelchairs and litters. Even the child who uses crutches may encounter restrictions in a traditionally designed school.

The major consideration in designing a special facility for the disabled child can be expressed in terms of those mobility limitations imposed by a wheelchair. Tucker (1964) specifically notes that dimensions and turning radius must be considered as well as limitations in the range of motion of persons confined to wheelchairs. Detailed specifications describing these factors are provided by the American Standards Association (1961) and Goldsmith (1963). When designing buildings to be used by children, average dimensions cited in these sources may require modification as a function of the age group involved.

Figure 1 shows a lowered public telephone booth.

Fig. 1. A lowered public telephone booth for use by the disabled should be located in the building.

Whenever possible the ground around the site of the facility should be graded, so that it is level with the building entrance thus eliminating the need for ramps. In planning a new building, the generally recognized dictum, "the best ramp is no ramp" should be kept in mind. However, if geographic features of the site prevent or preclude ground level entrances or if an older building is being modified, the use of ramps is indicated. The following represent the essential criteria for ramps collected from a number of major sources: American Standards Association, (1961); Goldsmith, (1963); National Research Council, (1965); State University of New York, (1967); Tucker, (1964).

1. The maximum slope should be a 1 foot rise over a 12 foot run for unaided use by adults and 1 foot over 20 foot for young children.

2. For two-way traffic, curbed aisles each about 30 inches wide, divided by hand rails are suggested with the curb at least 2 inches high and 4 inches wide as a safety factor in case of loss of control.

3. Handrails at a suitable height for the age groups using the facility should be provided on both sides of the ramp.

4. The ramp surfaces should be of a non-slip material such as broom finished concrete.

5. Level areas at the foot and top of the ramp as well as rest areas for long ramps or ramps that turn should be provided.

The physically disabled student should be able to move independently and safely along key routes outside the building or between buildings. Barriers such as high curbs and manhole grates should be avoided. The pavement materials for major circulation routes should be fixed and firm with filled joints and not slippery when wet. The following criteria for walks are suggested:

1. The maximum gradient should be 1 foot in 20 feet, with level rest areas for long stretches.

2. There should be a continuing common surface, uninterrupted by steps or abrupt changes in level.

3. The minimum width should be 4 feet with preferred values of 4 feet 6 inches to 5 feet.

4. As in the case of ramps, walk surfaces should be constructed with a firm, non-slip material, such as broom finished concrete.

5. Intersections with curbs and roadways can be handled in any of the following ways which are listed here in order of preference and safety:

a. curb cut and walk ramped to curb level.

b. continuing the line of the curb and providing a short ramp.

c. inclining the pavement gradually to the level of the road surface. This latter approach may provide a hazard to the blind since he does not have the conventional cues of approaching intersections and roadways.

6. Gratings should have a maximum opening of 3/4 inch square with manhole or access covers flush with adjacent pavement or road surface. The best solution would be to avoid locating such obstructions or hazards in major traffic areas used by pedestrians.

After providing for mobility around buildings as well as to a major entrance, some consideration must be given to the design of doors and doorways. The type of door used will depend upon its location. The following guidelines are offered:

1. The surface in a doorway should be smooth, hard, non-slippery, without a threshold.

2. Automatic opening doors actuated by contact mat sensing devices are recommended at the major entrance. Automatic sliding doors are not recommended since the doors cannot be manually operated when the power fails. Time delay mechanisms are considered hazardous since the speed of movement of disabled persons is likely to be so variable that a single automatic time control would be inappropriate.

3. The clear opening in a doorway (including any space taken up by the door itself) should not be less than 30 inches. Some authorities suggest other minimum values. The American Standards Association (1961) suggests 2 feet 8 inches and the State University of New York (1967) suggests 3 feet.

4. Both sidehung and sliding doors can be used by the physically disabled if they are properly located and equipped with appropriate hardware.

5. Revolving doors and single or double leaf doors are hazardous and should be avoided.

6. Doors should have a clear glass panel to avoid accidents. The door should have a panel starting no less than 3 feet from the floor for a full

window or have a narrow 6 to 8 inch wide strip of safety glass starting above the kick-plate and extending upward along the free swinging edge to a point about eye level for a standing person.

7. Door handles should be positioned not more than 3 feet 6 inches from the floor with a preferred height between 3 feet and 3 feet 3 inches.

8. Lever handles are preferred, especially for those with weak or prosthetic hands, although large, knurled knobs may be used. Auxiliary door pull handles may be used as an aid to wheelchair users. Experience at Human Resources School has shown that lever handles are best since they do not require strength and are assisted by gravity.

9. Doors should be equipped with kick-plates 16 inches high to prevent damage and marring from wheelchair footrests, crutches, canes, or other prosthetic devices.

10. Doors should be recessed to permit them to open without protruding in corridors and creating hazards (Salmon & Salmon, 1959).

11. The floor on the inside and outside of each doorway should be level for a distance of 5 feet from the door.

Figure 2 shows a wide automatic doorway activated by a contact mat sensing device.

The corridors and hallways in a facility serving the physically disabled should be eight feet wide to allow for the simultaneous passage of two wheelchairs. Smaller or access hallways need not be as wide as the main passageways but should allow for the complete revolution of a wheelchair which usually requires five feet. There has been some controversy as to whether or not handrails should be used in school corridors. Schoenbohm (1962) feels that handrails are essential while Wirtz (1965) feels they may act as a deterrent in a child's learning to use his wheelchair or crutches properly. While each position has merit, experience at Human Resources School indicates the elimination of handrails in corridors has encouraged independence and proper use of prosthetics and more closely approximates the conventional facility.

It is essential that floor surfaces have satisfactory non-slip properties (American Standards Association, 1961; Goldsmith, 1963; National Research Council, 1965). This can be achieved either by using materials such as rubber and vinyl tiles or avoiding highly polished finishes and employing non-slip waxes on standard floor materials. Materials that become slippery when wet should be avoided, particularly in vestibule and entrance hallway floors. Figure 3 shows a wide hallway with a non-slip floor surface.

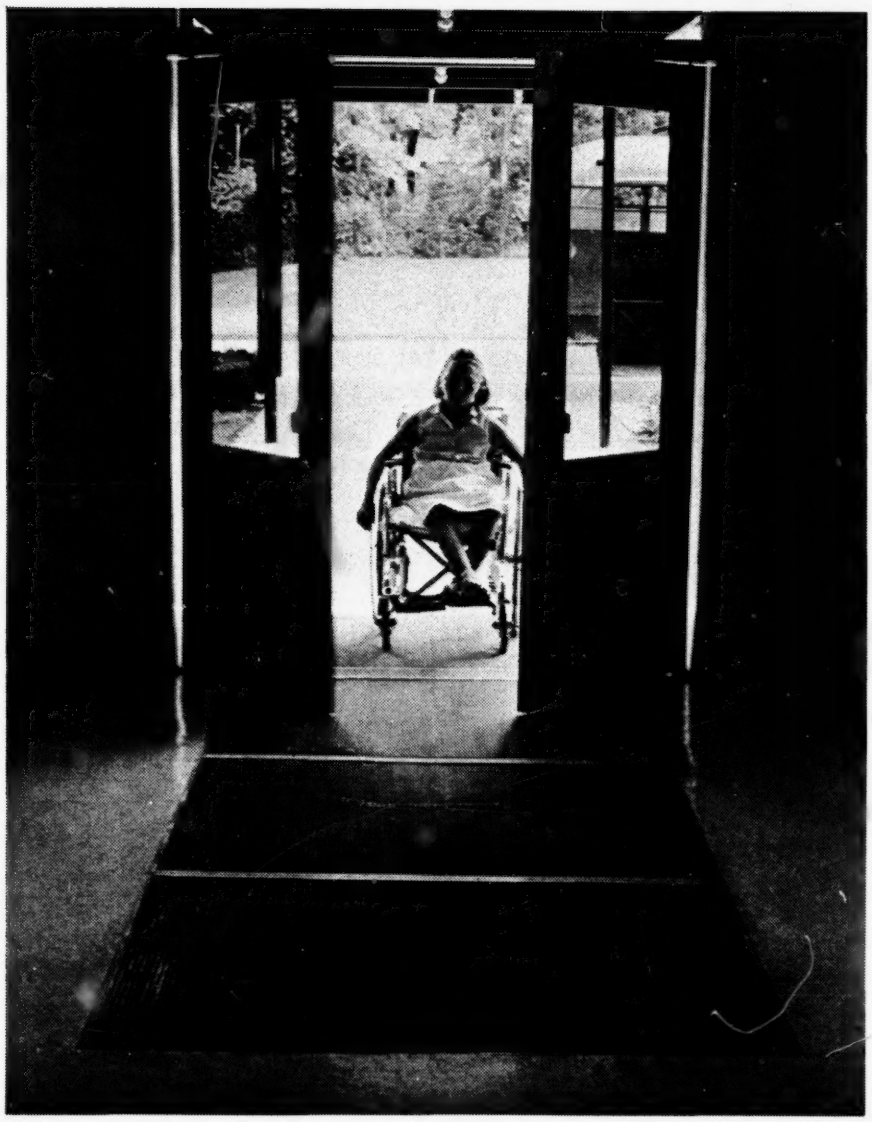

Fig. 2. Automatic opening doors are actuated by contact mat sensing devices at major entrances. The doors are equipped with clear glass panels for safety.

While it would be most desirable to eliminate stairways in a facility serving the physically disabled, obviously this is not always possible as site space limitations might dictate high rise construction in new buildings and already existing facilities might be multi-level. Scheduling classes that include physically disabled on the first floor of a multi-level building, whenever possible, can solve some mobility problems. However, beyond this, provisions must be made to increase the mobility of the semi-ambulant. For the semi-ambulant stairways can be designed to minimize safety hazards. The most comprehensive sources of information in this area are Goldsmith, (1963) and Yuker, Cohn, & Feldman, (1966).

Such staircases should have the following characteristics:

1. Adequate illumination

    a. natural lighting not less than one per cent daylight factor (Goldsmith, 1963).

Fig. 3. Major corridors and hallways should be wide enough to allow for two-way wheelchair traffic. The floor should be covered with a non-slip surface material.

2. The preferred height of each rise should be not more than 6 inches and the depth not more than 11 inches (Goldsmith, 1963).

3. A non-projecting chamfered nosing is recommended (American Standards Association, 1961; Goldsmith, 1963; National Research Council, 1965; State University of New York, 1967).

4. All surfaces should be non-slip.

5. Handrails 32 inches high as measured from tread at the face of the riser, or dual handrails at heights appropriate to the age groups being served should be provided (American Standards Association, 1961; National Re-

search Council, 1965; State University of New York, 1967).

6. One handrail that extends at least 18 inches beyond the top and bottom steps should be provided (American Standards Association, 1961; Goldsmith, 1963; National Research Council, 1965; State University of New York, 1967).

7. Handrails should be easy to grip with a diameter of 1-3/4 to 2 inches and be located 1-3/4 inches from the wall (Goldsmith, 1963).

The wheelchair bound individual obviously requires an elevator for mobility within a multi-level building. Essential features of elevators that will be used by physically disabled persons include:

1. An unobstructed clear space of at least 5 feet in front of the elevator door (Goldsmith, 1963).

2. A minimum clear opening of 2 feet 8 inches (Goldsmith, 1963).

3. Doors with safety or sensitive edge to stop and re-open obstructed doors (Goldsmith, 1963).

4. Automatic closing doors that remain open at least six seconds with seven seconds preferable and eight seconds desirable at ground floor level.

5. A door closing speed of not less than three seconds with a preferable minimum of three and one-half seconds.

6. The elevators should be automatically self-leveling and must stop precisely at floor level (Goldsmith, 1963).

7. While car platforms 3 feet wide by 4 feet 3 inches deep have been successfully used (Yuker, Cohn, & Feldman, 1967), a minimum internal size of 3 feet 6 inches wide by 4 feet 11 inches deep is suggested by Goldsmith (1963). To allow for a wheelchair to be turned, an additional 1 foot in the width of the cab is suggested.

8. For wheelchair users the controls should be easy to manipulate and be no higher than 4 feet 5 inches above floor level.

9. The usual safety features naturally are included and should be placed at an accessible height.

CLASSROOMS

Careful planning of classroom layout is essential in every school and certain basic features of efficient design are common to the education of all types of students. There are certain variations, however, which must be considered for disabled children. These modifications may vary according to the nature of the disabilities served and the children's ages.

1. The size of classroom areas on a per pupil basis in a school including disabled students should be larger than in a conventional school. There must be sufficient space in the classroom for maneuvering wheelchairs, for walking with crutches, for extra items of equipment, and for wheelchair storage in those cases in which the child can comfortably seat himself on a chair. It has been suggested that at least one third more space is required for physically disabled students in comparison with non-disabled children.

The average classroom for disabled students should be designed to accommodate not more than 15 students (Educational Research Services, 1963). For grades one through six, classroom minimum dimensions should be 24 feet by 30 feet. For higher grades the classroom space requirement for 15 pupils is 24 by 24 feet. Schoenbohm (1962) disagrees with the optimum class size suggested here and recommends that the class size should range from 8 to 12 children. Wolf (1967) suggests somewhat larger minimal values. He recommends 60 square feet of floor space per child to allow for movement of wheelchairs, walkers, and other equipment.

With regard to room shape, Wirtz (1965) claims that classrooms should be closer to square than rectangular shape to provide adequate aisle space. Aisles should be at least 4 feet 8 inches wide to permit two wheelchairs or two pupils using crutches to pass safely, and to provide slightly more space than usual for getting in and out of chairs (Educational Research Services, 1963).

2. The placement and location of windows and doors, the ventilation system, lighting, etc. are often the same for disabled and non-disabled students. However, a few changes which should be considered in designing facilities for physically disabled students will be mentioned here.

In designing a new building, plans should be made for two doors in each classroom. One should lead in from the hall and a second, lead out of the building. This is important for safety or in case of fire or emergency and is suggested in consideration of the congestion that can be caused by several wheelchairs trying to get through a single door. The exterior door should be equipped with horizontal push bars (panic bars) in conjunction with suitable

roller catches so that a person in a wheelchair can open the door with ease. The panic bar should be set at a height of about 32 inches. Figure 4 shows an exterior classroom door equipped with a panic bar.

Fig. 4. Exterior doors should be equipped with panic bars for easy opening by a person in a wheelchair.

All electrical switches should be conveniently located. Where adjacent to doors, switches should be the same level as door handles at a height of between 32 and 42 inches above floor level (Goldsmith, 1963). It has also been suggested that light switches be at the lock side of doors (Educational Research Services, 1963). Electrical outlets should be placed in unobstructed, easily accessible positions, at a height of between 27 and 32 inches above floor level (Goldsmith, 1963). A minimum of two duplex electrical outlets per teaching station is suggested to permit full use of electrical teaching aids.

In any school it is desirable to provide as many windows as possible especially if the school is located in an interesting setting. If floor length windows are used, Schoenbohm (1962) suggests that a railing in front of the window be installed to prevent disabled children from falling or stumbling

into them. It seems preferable, however, to have the lower edge of each window 12 to 14 inches above ground level and to provide window sills or storage beneath them. Most wheelchair bound children can see through a window which is as much as 24 inches above floor level. Figure 5 shows a classroom window located at an appropriate height for wheelchair individuals, with storage cabinets below.

Fig. 5. Classroom windows should be placed at appropriate height for wheelchair students. Cabinets for storage space may be provided below the window.

Indirect lighting is recommended for use in classrooms to eliminate glare. According to Schoenbohm (1962), general classroom activities may be conducted under as little as 30 foot candles of lighting but 50 foot candles is usually suggested. Optimally, from 125 to 175 foot candles of light should be provided as is done at Human Resources School (Better Light Better Sight News, 1966).

At Human Resources School well-distributed lighting is available through rows of three-lamp fluorescent fixtures. Most teaching areas are il-

luminated by three parallel rows of these fixtures bringing lighting levels to 125 foot candles.

The utilization of below window radiators has been most successful at Human Resources School. These units provide both hot and cool air and take up relatively little space. They project out approximately nine inches from the wall and each unit is under individual control. Additional temperature control is provided by fan coil units in office areas and an air-handling unit in the auditorium (Better Light Better Sight News, 1966). Air conditioning is necessary particularly for those children with cardiac conditions and respiratory conditions.

3. Layout of fixed and movable classroom equipment such as blackboards, cabinets, work counters, desks, chairs, sinks, etc. requires a few special considerations.

Blackboards or chalkboards may be installed with the lowest edge approximately two feet from the floor for use by seated students. Vertical and horizontal support railings may be provided at the edges of the blackboard for those students who can stand. Schoenbohm (1962) notes that although handrailings along the edge have been suggested, the same results can be achieved by having the chalk tray built with a strong curved edge to support smaller children without an additional barrier which wheelchair children would have to reach over when using the board. For older children who need some support, a vertical bar placed at the right and left edges of the board (so that it is convenient for both right and left-handed children) is more practical than a horizontal one. Some schools use vertical bars built so that they slide along the blackboard. However, this type does not offer sufficient support and stability for children unable to stand alone. To provide better legibility and enable teachers and pupils to use the bottom portion of the board, blackboards may taper out from the wall at the bottom from 4 to 6 inches. They can also be hinged and moved with a screw device as far from the wall as desired. Blackboards may also be constructed so that they can be raised or lowered.

For younger children who will work with finger paints, clay, and sand, running water in each classroom is useful. To be practical, a sink should project into the room. It should be accessible from three sides and have space underneath to permit children in wheelchairs to get closer to the fixture. Work areas like the counters surrounding the sink should be from 24 to 30 inches in height; they should be covered with a durable and washable formica or plastic material (Schoenbohm, 1962).

Classrooms for disabled children should provide adequate storage areas for special equipment which they may require (Educational Research

Services, 1963). Movable equipment such as overhead projectors, easels, typewriters, etc. should be stored within the student's reach. Inconspicuous, recessed storage for this equipment beneath window counters and in full length closets with sliding doors is desirable for both aesthetic and safety reasons. In a classroom for younger children, low book shelves where reference materials and other reading materials may be kept are practical so that the children may learn to work independently. A discussion of furniture and equipment for classrooms used by physically disabled students may be found in Monograph #9 in this series, Educational and School Equipment for Physically Disabled Students.

SCIENCE LABORATORIES

In most schools science laboratories have been consistently "off limits" to the physically disabled student. Teachers and administrators fear that the disabled student is likely to be injured in the laboratory. In many cases, poor design of the laboratory represents the major inhibiting factor. Work stations are frequently too high, crowded together, or completely inaccessible. Equipment is difficult to reach or hard to use by other than the non-disabled. With some thought to design, most of these hazards can be removed, greatly reducing the possibility of accidents. Human Resources School is one of the few schools with an adapted science laboratory. Suggestions for equipping a science laboratory that will be used by physically disabled students have been made in Monograph #9,in this series, Educational and School Equipment for Physically Disabled Students.

The efforts made to ensure an accessible and safe science room for the disabled will undoubtedly result in a room that is less hazardous to the non-disabled.

The following design considerations for a science laboratory are suggested:

1. Work areas that are mounted at wheelchair height along the perimeter of the room. This arrangement reduces the overcrowding that usually occurs with centrally located work stations. When the center of the room is kept free, the space can be used as a lecture area thereby allowing the room to be used for non-science subjects as well.

2. Sink should have the same design features as described in the sanitary facilities section of this report.

3. A student work area of 4 feet with 8 feet between successive sets of gas, water, and electrical outlets, is recommended. The controls on outlets should be easy to manipulate.

4. Storage should be provided alongside the work area and beneath the work surface. This is necessary if students are to have access to work areas and stored equipment.

It can be seen that a laboratory serving students with physical disabilities differs from a conventional one only in respect to allowing more space per pupil, and providing accessible work stations and storage areas.

Figure 6 shows the work area in a science laboratory.

Fig. 6. In the science laboratory the work areas should be mounted at wheelchair height along the perimeter of the room. Storage is provided along the work area and beneath the work surface.

APPLIED SKILL AREAS

Many applied skills such as home economics, activities for daily living (ADL) and industrial arts can provide valuable educational experiences for the physically disabled child. Certain general principles should be followed in the design of areas in which these subjects are taught. These include provision of sufficient space for maneuvering by students in wheelchairs or using crutches. Work areas and required fixtures and equipment must be set at heights and locations which are convenient, accessible, and safe.

A multipurpose room in which basic home economic skills as well as ADL can be taught has been described and diagrammed in a report by Human Resources Foundation and Educational Research Services (1963). The basic plan divides the room into areas devoted to:

1. food preparation
2. living-dining
3. clothing-textile
4. laundry-workshop-storage

The report includes a table of working heights for disabled students in elementary and secondary schools for a wide variety of equipment used in developing skills in home economics and activities of daily living.

A most comprehensive analysis and discussion of the kitchen area in a home economics classroom has been provided by McCullough & Farnham (1961). Data pertaining to work centers, storage units, cabinets, appliances, and kitchen arrangement based on a study of 26 women confined to wheelchairs is provided. The authors point out that although these kitchens are planned for women in wheelchairs, the storage arrangement shown will be convenient for everyone.

A thorough and comprehensive discussion of an ADL room may be found in Lawton (1963). She contends that while many feel ADL can be practiced anywhere, efficiency and encouragement are gained in a homelike atmosphere which is planned in terms of easy reach and minimum output of energy. This is in keeping with the concept of "modern living" in which the practical and the attractive are combined. Lawton also presents a floor plan (including dimensions) and equipment requirements for the ADL room.

LIBRARY

In discussing the physical plant layout of a school for the physically disabled the need for complete library facilities and services cannot be overemphasized. While this is true for all children it is particularly true for the disabled in that reading represents an extension of their lives.

Schoenbohm (1962) suggests that library facilities for the special school be planned much like any public school library, but with certain modifications. Many of the library users will be in wheelchairs and their book rack levels must be designed accordingly, and be somewhat lower than standard height. In addition, apronless reading tables should be of the type which permit a wheelchair to roll part way under for reading comfort.

Schoenbohm feels that while library services for the lower grades can be provided in the classroom, a separate library is important for the older students. He suggests that the size for a small library be 20 by 30 feet, with areas below the windows used for shelves which children can reach easily.

The library staff at Human Resources School feels strongly that a central library facility is advisable for primary and secondary grade students. Instruction in the use of a library begins in third grade when children are taught to locate books on the shelves by using the card catalogs. By bringing the primary school grades to the library once a week for story hour, a variety of library materials is introduced. This is considered an important addition to the regular classroom use of books.

In designing the library at Human Resources School the primary objective was to demonstrate that disabled children do not need extensive adaptation of the normal environment in order to function successfully. Ground level entrances, widened halls and doorways and in the library, bookshelves and a card catalog low enough to be reached by wheelchair students, are the necessary exceptions (Velleman, 1964; Vellman, 1966).

The library at the School has 1,200 square feet of space. All walls are interior, allowing for unbroken shelf space, but a picture window and door provide a view of an adjacent greenhouse. The library thus avoids becoming a confining enclosure, offering an atmosphere which opens out, rather than restricts. It was felt that this is important to children who have been homebound and who still spend much of their time at home.

The floor is covered with a commercial grade tackless carpet which features a tight weave, looped through the back, and thin 32 oz. jute padding. The thresholds consist of metal strips with a gripper edge instead of conventional sills to provide a flush and level entrance into the library. Since wheelchair

bound persons may have difficulty in moving on most carpeting, this is an important consideration.

In addition to reducing the noise level to one acceptable for libraries, the lower reflectance level of the blue carpeting used in this room also reduces lighting requirements to about 110 foot candles as compared to 125 to 175 foot candles used in classrooms (Better Light Better Sight News, 1966). Walnut shelves and colorful lounge furniture grouped around a wood burning fireplace contribute to an atmosphere of informality and comfort in the library room. There is a quiet study corner for older students furnished with four individual study carrels.

Although a regulation charging desk is used, the central library at Human Resources School incorporates the following innovative guidelines in its design:

1. Storage shelf space does not exceed heights of 5 feet. Bulletin boards and closed storage utilize upper shelf space.

2. Periodical and newspaper racks do not exceed a height of 5 feet.

3. Card catalog is on a 16 inch base and does not exceed a height of 3 feet.

4. Individual study carrels are set at 29 inch table height.

5. Twenty-three inch high tables are used for primary grade children.

6. Revolving dictionary stand on a 16 inch table base allows foot room for wheelchairs.

7. Five feet of space between tables and book shelves allows passage of wheelchairs.

8. Audio-visual and vertical file cabinets have three drawers.

9. Doors leading into library are provided with see-through panels, lever handles rather than knobs, and kick-plates.

10. Electrical outlets in individual carrel areas permit the use of elecrical teaching aids.

It must be stressed that a spacious floor plan should be maintained to permit free passage of wheelchairs. Closed stacks are not as readily accessible to wheelchair students as open shelves and tend to be more conducive to accidents.

One corner of the library at Human Resources School serves as a work area. It is partially closed off by double-faced book shelves and files. It contains a formica topped table and a sink with drains at the rear corners. The base below the sink is cut away ten inches from the floor to allow for wheelchairs. The upper storage unit in the work room areas has sliding doors.

CAFETERIA

The design and plans for a dining hall in a school for the physically disabled need not differ radically from normal cafeteria planning. The major consideration in planning for a special school is the provision of sufficient space for children in wheelchairs. According to the Superintendent of Public Instruction of the State of Illinois (1961) the dining area should allow for approximately 24 square feet of floor space per disabled child.

Schoenbohm (1962) suggests that dining facilities be small, since the noise and activity levels usually found in large cafeterias are not conducive to relaxation and good eating habits. This is especially important for certain categories of disability. If the existing dining hall is large, folding doors may be effectively used to divide the room into smaller units.

In the Illinois Hospital-School (Schoenbohm, 1962) separate dining rooms are provided for different age groups, each accommodating about 20 children. In the Iowa Hospital-School (Schoenbohm, 1962) there are two dining rooms, each 24 by 26 feet. Each is equipped to handle 20 to 25 children and is arranged so that one kitchen can service both.

At Human Resources School elementary level children eat in a multipurpose auditorium. They bring their own lunches and buy milk brought into the school. The students eat at formica topped tables that can be folded easily by one person and stored against the walls when not in use (SICO, Inc.). Lightweight folding and stacking chairs are kept under the stage area in the room, thus providing maximum utilization of space. Secondary level students are allowed to eat in the Human Resources Center cafeteria which is used by the professional staff and the employees of the Center and Abilities, Inc. It is felt that this opportunity for interaction with disabled and physically normal adults is a valuable learning experience for the older pupils.

Food Service: The serving tray slide can usually be set at the conventional height of 34 inches (although 32 inches is preferable) to make it easier for the wheelchair bound individual to reach for plates and trays, etc. The area between the serving tray slide and the control railing should be a minimum of 34 inches wide to allow adequate room for wheelchairs (State University of New York, 1967).

Self-service beverage or water faucets can be of a standard model which permits a glass to be placed on a counter surface while being filled (State University of New York, 1967).

Seating: Dining hall furniture should be planned to suit the needs of the children it will serve. Counters and tables should be accessible to children in wheelchairs. Tables should range in height from 22 inches for preschool children to 28 inches for adults (Schoenbohm, 1962). The number of children in each age range must be considered in determining the number of tables and chairs of each height. Although low tables increase the problem of providing assistance when required for certain students, this can usually be overcome by having the attendants use relatively low chairs.

Rectangular tables, not equipped with aprons, are generally preferable to permit maximum utilization of available space (Schoenbohm, 1962).

Since many children may wear braces or use crutches which may scratch or mar the surface of veneered or painted furniture, the chairs should be made of durable, scuff proof materials. Schoenbohm (1962) notes that lightweight, stacking chairs of plastic and aluminum now on the market are very practical for dining areas.

Other Considerations: Dining areas are usually designed to include space for storage of standard supplies such as napkins, napkin holders, sugar bowls, etc. In a school for the disabled, extra storage space should be provided for items such as straws and bibs. There should also be provision for space to keep special feeding equipment such as feeding boards, suction cups and plates, special spoons, knives and forks, etc. These items are described in greater detail in Monograph #9 in this series, Educational and Physical Equipment for Disabled Students.

RECREATIONAL AREAS

Pomeroy (1964) points out that facilities used for recreation programs for physically disabled individuals can vary, as with any group, from basement rooms to large recreation buildings containing auditorium, gymnasium, and activity rooms. Whatever the degree of elaborateness of the facility, it should be such that the disabled will be able to help themselves with a minimum of assistance. Ideally, new structures can and should be designed and built in such a way that physical barriers to the disabled are nearly or completely eliminated. In existing buildings or recreational areas a number of modifications may be desirable or necessary to make the facilities available to individuals with physical disabilities.

Pomeroy (1964) mentions the following common modifications in existing facilities having recreational programs for the disabled:

1. Ramps installed at entrances, exits or wherever steps would otherwise be needed. The ramps may either be temporary or permanent.

2. Handrails, where needed, to encourage self-help and independence of persons on crutches or otherwise ambulatory.

3. Doors large and safe enough to accommodate persons in wheelchairs, on litters, or paraphenalia used in the program.

4. Floors and paved areas constructed of non-slip material.

The last two modifications are features that would improve any recreational facility independent of the kinds of persons using that facility. While there might be some reluctance to include handrails in a structure that is being newly constructed, and intended for both disabled and non-disabled individuals, the other recommendations do not appear highly unreasonable. In fact, there is some feeling among experts that handrails, even in facilities specially intended for the physically disabled should be kept to an absolute minimum in order to foster independence training and reproduce real life situations.

Playgrounds: Outdoor recreational facilities, while they may appear to be only slightly modified to the layman, do require careful planning and consideration for the physically disabled. The two most important factors are mobility and safety. Paths and play areas should be graded level with a smooth surface for movement. Black top or cement paths should be considered for movement through sandy or heavily wooded areas in order to provide access for children using crutches and wheelchairs. In areas for court games such as

basketball, volleyball, and softball, cement should be avoided and black top used, with a hard enough consistency for movement and soft enough for some safety. Sealant should be applied periodically to prevent softening in extreme heat. Grass should generally be kept to a minimum for paths since it impedes wheelchairs.

A number of new materials are now available which may cost more but are worthwhile for safety and ease of movement. Indoor-outdoor carpet could be considered for areas such as miniature golf. Astroturf, (Monsanto) an artificial grass which comes in various grades, could be used in playgrounds.

The surfaces around playground apparatus can be cushioned by a product such as Voit Safety Cushion manufactured by American Machine and Foundry, which in addition to protecting any disabled or non-disabled child from injuries and falls, provides a surface that does not become muddy or slippery when wet. The cushion is constructed of interlocking sections of chlorinated butyl rubber and can be quickly assembled into any shape or size. Additionally, this product presents no lip edge or retaining wall that can trip or be a physical barrier to a child, as the edges are ramped so that play equipment is made easily accessible to the wheelchair bound.

Schoenbohm (1962) includes the following requirements for outdoor play areas for students with physical disabilities:

1. Access to toilet and drinking facilities.

2. Sunny and shaded areas.

3. Room for activities like digging, planting, quiet play, wheel toys, and fixed equipment, at least 75 square feet per child.

4. Large enough for free movement.

5. Fencing with self-locking gates to preclude the possibility of children finding their way into the street.

Gymnasium - Auditorium: There appears to be no reason why recreational areas in a newly designed modern building, like a gymnasium or an auditorium, should not be suitable for use by physically disabled students. As long as the room is accessible only the particular recreational activities and equipment used would distinguish programs for disabled and non-disabled students. At Human Resources School (serving only the physically disabled) the gymnasium, lunch room, and auditorium have been successfully combined in

a single room. Nimnicht and Partridge (1962) discourage this practice pointing out that "conflicts of interest between the dramatics teacher and coach and scheduling conflicts between athletic and other events inevitably follow" (p. 60). They suggest combining the stage with the lunchroom to form what is usually called a "multipurpose room" to reduce conflicts, and present plans describing how the gymnasium - auditorium problem has been solved in some schools. The writers of this monograph wish to point out that the multipurpose concept works well at Human Resources School which has a school population of 200 children. In a school with a larger pupil enrollment while some conflicts may occur, they are rare if an adequate schedule has been planned. The important concept of the multipurpose room is that it can be used throughout the school day, rather than stand idle.

Auditorium: According to Schoenbohm (1962) a separate auditorium can be an important unit for the recreational, as well as educational development of children. In large auditoriums with sloping grade floors and stationary seats, the rows should be 36 inches apart. Level areas in the front, middle, and rear should be provided for wheelchairs. Too many times, the wheelchair bound are relegated to the back of an auditorium or directly up front. If the floor is level, movable seats in tiers which can be stored under the stage, as well as folding or stacking chairs can be used for seating purposes. The stage area should have a ledge to prevent wheelchairs from rolling off. A ramp, in addition to stairs leading to the stage, should be provided. The light panels and public address systems behind the stage should be at wheelchair height. A few removable seats at level areas in an integrated school might be considered. Providing for these basic features in a new building or modifying existing facilities in the manner described should make the auditorium available to students with physical disabilities.

SWIMMING POOL

Most experts in physical education agree that swimming is an unusually effective contribution to physical fitness. Consequently, designers of educational facilities for physically disabled children should consider the possibility of including a swimming pool. Modern construction techniques and materials have reduced the cost of swimming pools dramatically. Evidence of this can be seen in the large number of "built-in" private swimming pools in middle class communities. While it is difficult to think of the swimming pool as a necessity, the gains to be realized should not be overlooked and should be weighed against the cost involved.

The Human Resources Center includes an indoor swimming pool which is used by the children at the school as well as the workers at Abilities. The pool is 30 by 60 feet and has a depth ranging from three to eight feet. The heating, filtering, and recirculating systems are standard equipment, but the pool includes a number of special features for use by disabled children which are described below.

The sides of the pool are 19 inches above floor level which is the height of a standard wheelchair. Thus, a chair can be brought directly to the ledge so that the child may be easily transferred to the pool. The coping around the pool is made of a natural-finish marble with smooth, sanded edges. This ledge extends far enough over the outer edge of the pool so that wheelchair pedals can fit comfortably underneath.

The water in the pool is kept at a higher level than usual for easy access into and out of the pool. Where the usual water level is about 12 inches below the top of a pool, the Center's pool water level is only six inches below the edge. The water temperature of the pool is maintained at 80-82 degrees due to the children's disabilities and their limited motion. The air temperature in the pool area is kept within five degrees of this for comfort and prevention of colds.

The floor surface in this area consists of non-skid, heated tiles. The aisles around the pool are about six feet wide to allow two wheelchairs to pass at the same time. Benches and lounge chairs placed around the pool are wheelchair height. Figure 7 shows a student transferring from wheelchair to swimming pool, and Figure 8 shows the 19 foot ramp at the shallow end of the pool at Human Resources Center.

Access to the water is provided for in several different ways. There are five sets of parallel assist bars set around the coping to aid people who can use their arms. The pool is equipped with two conventional ladders for ambulatory persons, with a non-skid pad set in the coping between the rails for safety. At

Fig. 7. The swimming pool at Human Resources School has many special features. The coping is wheelchair height for easy transfer to the water.

the shallow end of the pool there is a 19 foot ramp with a 15 per cent grade, which ends at a water depth of 3-1/2 feet. Here, there are also two steps 28 inches wide with a six inch rise which lead up to the coping, and six more steps which descend into the pool for a distance of eight feet, to a water depth of three feet. Double hand rails along these steps continue into the water for a distance of eight feet. This end of the pool also has 12 foot long parallel bars which are used for exercise and support.

The pool is also equipped with a Hoyer hoist (Ted Hoyer & Company) which is easily controlled by an aide or a lifeguard. A Hoyer hoist is a canvas stretcher suspended on a track. It is used for quadriplegics and severely involved persons who can be transferred directly onto it from litter or wheelchair, and then lowered directly into the pool.

Fig. 8. One of the several different methods of entering the pool at Human Resources School is a 19 foot ramp at the shallow end.

The pool area contains an emergency button which rings an alarm in the medical department when the assistance of a nurse or doctor is required.

SANITARY FACILITIES

In a school with physically disabled students in attendance, the location and layout of sanitary facilities are of prime importance. Toilet facilities should be easily accessible and equipped so that independent functioning is made possible. The sanitary areas should be centrally located in the school rather than placed at the end of corridors. Such an arrangement should prove convenient to all students. When young children or many disabled students are involved, the practice of providing direct access to a toilet room adjoining the classroom has some advantages in that congestion is avoided and some time may be saved (Illinois, State of, Office of the Superintendent of Public Instruction, 1961). Experience at Human Resources School indicates, however, that it is generally less distracting for the student to leave the room and use a nearby facility.

Where doors are used, in-swinging doors should be avoided in view of the limited space available in wash room areas and the resulting congestion and possible hazards (Goldsmith, 1963).

In existing structures, it is usually not necessary to modify the entire sanitary facility. A reasonable practice is to provide adapted stalls in proportion to the number of physically disabled students in the school population. The American Standards Association (1961) recommends that sanitary facilities in any public building have at least one toilet enclosure that can accommodate physically disabled individuals, particularly those in wheelchairs. Figure 9 shows a standard toilet stall, and one which is wide enough to accommodate a wheelchair.

The adapted enclosure should include the following:

1. A minimum width of 36 inches with 54 inches preferred and a depth of 60 inches (Goldsmith, 1963; Schoenbohm, 1962; State University of New York, 1967).

The wider stall should be incorporated in schools where disabled children need assistance. This extra width allows the aide ample space to assist the child in transferring from the wheelchair to the bowl. With disabled children who are severely involved and overweight a portable Hoyer lift could be used as well.

2. A sliding curtain in lieu of a swinging door so as to minimize interference with a wheelchair and still provide privacy for the user.

3. Grab bars installed at suitable heights on either side of the bowl (American Standards Association, 1961; Goldsmith, 1963). The Beneke Cor-

Fig. 9. Sanitary facilities should include at least one toilet enclosure which can accommodate the physically disabled person, particularly one in a wheelchair. This stall should have a sliding curtain and grab bars placed at suitable heights on either side of the bowl.

poration manufactures a number of sheltering arm seats that can be attached to regular bowls. This unit is self-supporting requiring no wall or floor support.

4. A bowl should be centrally located at a height of 20 inches for adults, 10 inches for young children, or at wheelchair seat height.

5. A water closet designed to allow for frontal approach of a wheelchair without obstructing the footrest. Wall mounted fixtures are preferable but floor models with receding understructures may be suitable. The flushing control should be hand operated and easily reached with lever handle or pull knob handle preferred (State University of New York, 1967).

Similar considerations should be adhered to in the installation of urinals. While the physically disabled student will probably prefer to use an enclosed stall for privacy (State University of New York, 1967), wall or floor mounted urinals should be accessible also. Grab bars should be installed to provide support, and mounted at suitable heights for the age levels being served. Floor urinals should have the opening level with the main floor of the toilet room (American Standards Association, 1961). If wall urinals are used, they should be mounted below the seat height of a wheelchair for access. Figure 10 shows floor mounted urinals with grab bar at suitable height.

Fig. 10. Wall or floor mounted urinals should be accessible to the physically disabled. Grab bars should be mounted at suitable heights for the age levels being served. Note the male urinal also available for use by wheelchair students.

Sinks should be installed with the lowest edge at a height of 27 inches. Plumbing should be recessed so that sink controls may be easily reached by persons in wheelchairs. This also reduces the likelihood of physical injury

from hot water pipes. Faucets with gooseneck spigots and batwing taps are suggested since they require minimal strength and dexterity.

Towel racks or dispensers, soap dispensers, and disposal units should be easy to use and mounted no higher than 40 inches from the floor (American Standards Association, 1961). Dry soap dispensers of a type that require only a light touch on a button for dispensing are suitable for use by the physically disabled. Waste cans should be easy to reach and centrally located preferably between the sinks.

Mirrors should be angled forward and should be installed at a height of 69 inches at the upper edge. This enables easy viewing by the person in a wheelchair. Full-length mirrors may be used instead of or in addition to over the sink mirrors.

CLOSETS AND STORAGE AREAS

An important consideration in designing a school for physically disabled children is provision for adequate storage space. This is unusually important because many of these children require special equipment, much of which is not used regularly, but must be available when needed.

Storage areas can offer considerable difficulty to the wheelchair bound student if they are not designed properly. For example, the student may not be able to hang up his coat or reach his books without help in an inadequately designed storage area. The resulting student dependence on an aide, teacher, or another student frequently means wasted time at the beginning and end of the school day.

Clothing Storage: At Human Resources School the clothing storage areas consist of enlarged open closet rooms. Doors have been eliminated and an archway 78 inches wide is large enough to permit two wheelchair students to pass through the opening at the same time. Standard coat racks have been installed at suitable heights, with shelves above for books, etc. Figure 11 shows a clothing storage area at Human Resources School.

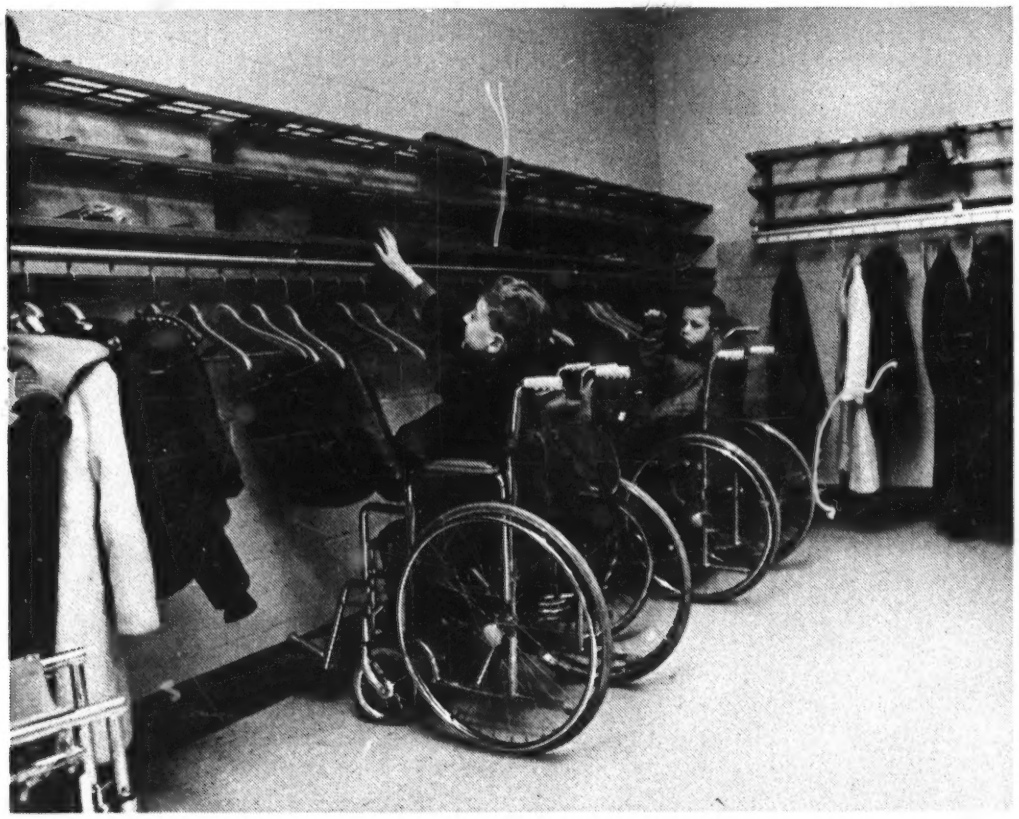

Fig. 11. One of the enlarged open clothing storage areas at Human Resources School. Coat racks and shelves are installed at suitable heights for wheelchair students. There is ample space for overnight storage of wheelchairs and walkers, etc.

Schoenbohm (1962) suggests a special storage room connected with the loading dock where the equipment used by students can be accommodated.

> A room 24 by 24 feet will provide space for 60 to 70 wheelchairs and walkers which should be adequate for a school of 200 children. Such rooms should have several double or 52 inch doors for easier access. A long shallow bay may be used if desired for storing chairs and walkers but will be less attractive. There should be a locker or cloak room as well as toilet facilities adjacent to the entrance (p. 202-203).

Since many pupils do not use wheelchairs during all periods of the school day at Human Resources School, the clothing area has room for storing wheelchairs for about half the number of pupils in the school plus a few spare chairs. While the wheelchairs can be folded, it is suggested that most remain ready for use to permit children to get them and use them unaided. The same area may also be used for overnight storage of the chairs (Educational Research Services, 1963).

If cloak racks are used for children and staff, they should be stationary as the disabled individual may use them for support. Benches, built in or securely fastened to the floor within or directly outside cloakrooms, are helpful dressing aids (Schoenbohm, 1962).

Lockers: Box lockers may be provided for small items, lunches, books, etc. which the student need not carry throughout the day. It is suggested that these be placed in recessed areas or away from the main flow of traffic. Avoiding the use of locks on these units permits greater accessibility for the student, particularly those with upper extremity involvement (Educational Research Services, 1963).

Supplies and Equipment Storage: Aisles should be wide enough for passage of wheelchairs. Cabinets along the walls should have lower sections equipped with drawers and bins for supplies and student projects. Upper sections should be limited to shelving. Shelves to be used by pupils should be fixed rather than adjustable, since they may be used for support by the students. High shelves will be of value only for dead storage or teacher use (Educational Research Services, 1963).

In classrooms, storage and cupboard space should be constructed with sliding wooden doors as some children can slide doors they cannot pull open. In addition, doors which open outward are a hazard and should be avoided. Storage cabinets and cupboards should be recessed to eliminate sharp protruding corners. They should be constructed to accommodate such items as three by four sheets of oaktag and newsprint (Illinois, State of, Office of the Superintendent of Public Instruction, 1961).

Schoenbohm (1962) notes that the amount of storage space in each classroom for books and materials will depend on whether a central storage room for educational supplies is provided. He also advises that wherever possible, storage places should be built in. Refer to sections dealing with specific school units in this monograph.

PARKING AREAS

Parking Lots: Many schools for disabled children include a number of physically disabled adults working as staff members. To the extent that this is the case, the design of parking areas becomes important. In order to allow disabled individuals to park and disembark with a minimum of inconvenience and high degree of safety, parking areas should include the following features:

1. The parking lot should have a number of clearly identified, reserved spaces located adjacent to sidewalks. The number of spaces required will vary as a function of the number of disabled persons using cars. Signs or pavement markings can be employed to identify the reserved spaces. Locating the spaces next to the sidewalks promotes safety by reducing exposure to parking lot traffic.

2. The parking spaces can be any of the three common designs, parallel to, head-in, or diagonal to the sidewalk. Parallel parking in which the right side of the car is closest to the sidewalk is desirable in that the disabled person can get safely in or out of the vehicle without having to go into the parking lot proper. However, unless there is a common surface from the parking lot to the sidewalk the space between the curb and the car can pose problems. Head-in or diagonal parking should use spaces that are larger than average width to allow for full opening of car doors and to permit the loading or unloading of wheelchairs (12 feet is recommended). Where sidewalks are curbed, curb cuts or ramped accesses from the parking space to the sidewalk are needed. The State University of New York (1967) recommends an aisle (preferably at sidewalk height) four feet wide between every two spaces when head-in parking is used.

3. The parking lot and adjacent areas should be paved with a level, firm surface so that the disabled person may position his wheelchair or step out with his crutches. Gravel and cobblestone should be avoided as these materials reduce mobility and can be dangerous to both disabled and non-disabled. The same is true for materials which tend to soften on exposure to heat.

4. Additional safety factors would include the placing of large signs at entrances and road crossings informing drivers that the facilities are used by the wheelchair bound, and the strict enforcement of speed restrictions. These safeguards are needed because a person in a wheelchair is more likely to be completely obscured from view by a parked car or other obstruction than a standing, non-disabled individual. A person using crutches or a wheelchair is also less mobile and would probably have more difficulty avoiding a quickly moving oncoming car.

Loading Areas: In primary or secondary schools, the use of a sheltered loading area for cars, station wagons, and school buses is recommended. Schoenbohm (1962) suggests sheltered driveways and loading areas in order to prevent unnecessary and possibly detrimental exposure to inclement weather. Schoenbohm also discusses a loading room in which a ramp or loading dock allows wheelchairs to be rolled directly to transporting vehicles. However, if such a room is not feasible, an overhead canopy running the entire length of the building and extending to every major entrance can provide adequate protection. This method has been successfully used at Human Resources School. Figure 12 shows a sheltered loading area.

Fig. 12. A sheltered loading area for cars, station wagons, and school buses is recommended. A canopy at the entrance affords protection from inclement weather.

REFERENCES

American Standards Association. American standard specifications for making buildings and facilities accessible to, and usable by, the physically handicapped. Chicago: National Society for Crippled Children and Adults, Inc., 1961.

Beneke Corporation. Sheltering arms seat. Columbus, Mississippi, not dated. (Brochure)

Better Light Better Sight News. A learning environment for overcoming severe handicaps. May-June, 1966, 2-5.

Educational Research Services. Program of requirements for a school for severely physically handicapped. Albertson, N. Y.: Human Resources, 1963.

Goldsmith, S. Designing for the disabled. London: RIBA Technical Information Service, 1963.

Ted Hoyer & Company. Oshkosh, Wisconsin, not dated. (Brochure)

Illinois, State of, Office of the Superintendent of Public Instruction. Guide for administrators establishing classrooms for physically handicapped children. Springfield, Ill.: Author, 1961.

Lawton, Edith Buchwald. Activities of daily living for physical rehabilitation. New York: McGraw-Hill, 1963.

McCullough, Helen E., & Farnham, Mary B. Kitchens for women in wheelchairs. Circular 841. Urbana, Ill.: University of Illinois, Extension Service in Agriculture and Home Economics, 1961.

Mackie, Romaine P. The crippled child. What is special about special education? Washington, D. C.: The Council for Exceptional Children, National Education Association, 1952-1953.

Monsanto. Astroturf Recreational Surfaces. New York, 1968. (Brochure)

National Research Council. Building standards for the handicapped. Ottawa, Canada: Author, 1965.

Nimnicht, G. P., & Partridge, A. R. Designs for small high schools. Greeley, Colo.: Educational Planning Service, Colorado State College, 1962.

Pomeroy, Janet. Recreation for the physically handicapped. New York: Macmillan, 1964.

Salmon, F. C., & Salmon, Christine. Rehabilitation center planning: an architectural guide. University Park, Pa.: The Pennsylvania State University Press, 1959.

Schoenbohm, W. B. Planning and operating facilities for crippled children. Springfield, Ill.: Charles C. Thomas, 1962.

SICO, Inc. The SICO system of table seating. Minneapolis, Minnesota, not dated. (Catalog)

State University Construction Fund. Making facilities accessible to the physically handicapped. New York: Author, 1967.

Tucker, W. V. (Ed.) Higher education and handicapped students. Emporia, Kansas: Kansas State Teachers College, 1964.

Velleman, Ruth. School library service for physically handicapped children: an account of the program at the Human Resources School, Albertson, N. Y. Unpublished master's thesis, C. W. Post College, 1964.

Vellman, Ruth. A library for the handicapped. School Library Journal, 1966, 13 (1), 48-52.

W. J. Voit Rubber Corporation. AMF Voit Safety Cushion. Santa Ana, California, not dated. (Brochure)

Wirtz, M. A. Something for the special child. American Education, 1965, 1 (6), 4-10.

Wolf, J. M. Physical facilities guidelines for handicapped children. School Management, 1967, 11 (12), 41-54.

Yuker, H. E., Cohn, A., & Feldman, M. A. The development and effects of an inexpensive elevator for eliminating architectural barriers. Hempstead, N. Y.: Hofstra University, 1966.

APPENDIX

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